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ABSTRACT

This paper discusses some of the reasons for the shortage of qualified computer studies teachers in South Africa, as well as problems with current training programs. It then focuses on a new innovative learning program, leading to a degree in science education, being developed at the University of South Africa for the preservice and inservice training of computer studies and computer literacy teachers through distance education. The paper highlights: specific outcomes of the program; the target market of the program; modules for the certificate; additional modules for the diploma; additional modules for the degree; and vocational opportunities. (MES)

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A New Program for the Inservice Training of Computer Studies Teachers Through Distance Education.

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Abstract:
There currently exists a crisis in education in the natural sciences (mathematics, physical science, computer science and biology) in South Africa (Arnott et al:1997). One reason for this crisis, is the huge shortage of qualified Computer Studies teachers. This paper will discuss some of the reasons for this shortage. It will then focus on a new innovative learning program (leading to a degree in science education) being developed at the University of South Africa (Unisa) for the preservice and in service training of Computer Studies and Computer Literacy teachers. Training will be done through distance education. The proposed didactical and subject related content of the new program will be discussed.

Introduction

There currently exists a growing demand for Computer Studies teachers at secondary school level and computer literacy teachers at primary school level in South Africa. Because of this great need, schools often use teachers from other disciplines (eg. mathematics, physical science and accounting) to teach Computer Studies. These teachers have no formal training in computer science and therefore don't have the necessary subject knowledge to teach the subject. The new program being developed at Unisa will specifically address this need.

Reasons for the Crisis in Computer Studies Education

The crisis, as far as teachers are concerned, can be attributed to a combination of two related causes:

- There exists a huge shortage in Computer Science teachers.
- This shortage has led to a large numbers of teachers from other disciplines, without any qualifications in Computer Science, being appointed to teach Computer Science.

One of the main reasons for the shortage of Computer Studies teachers, is the fact that the teaching profession in South Africa is currently typified by low morale. This is due to increasing difficulties in maintaining discipline and the inability to handle racial and other conflict amongst pupils. Parents are placing undue pressure on teachers to obtain unreasonably high results (especially in so called up market schools) . Furthermore, teachers find it difficult to adapt to new teaching paradigms (eg. outcomes based education) being employed by a new government.

Another reason, not unique to South Africa, is the relatively low salaries, which lead many teachers to the more lucrative business sector. Computer Studies is probably the school subject suffering the most due to this "greener pastures syndrome". Trained Computer Studies teachers are in high demand from businesses offering computer literacy training courses, companies training their own employees and even governmental technical colleges (which offer, if not much higher salaries, then at least higher "prestige" and less discipline related problems). Many ex-teachers simply start their own businesses, working from home, offering private computer literacy or programming courses. Some teachers even discard teaching completely and take up positions as programmers or other computer related careers.

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A third problem, more unique to South Africa, is the so called "brain drain" experienced by the country since Å1994. A great number of young, newly qualified teachers, leave the country to teach and gain experience, mostly in Britain, wherethey seem to be in high demand, and other European countries.

A problem that new teachers find very annoying and time consuming, are the prevention and elimination of viruses and the repairing of damage caused by hackers. Computer Studies learners are often highly gifted individuals with their own computers at home and too much time on hand to experiment. It often gives them great satisfaction to hack into or disable the computer network at school.

Many teachers have to teach in a school environment where they get little or no support from colleagues and principals who do not understand the unique nature and problems facing the Computer Studies teachers. They normally are the only teacher teaching the subject at their particular school. For the beginner teacher this means that no advice from experienced teachers is available. They often have to set up the computer centre, take responsibility for the everyday functioning there of, *and* help administrative personnel with any computer related problems. For many beginners, this daunting task is the final straw to break the camel's back.

Problems with Current Training Programs

The new program should cater for the training of new teachers (thus students fresh from school) *and* the in service training of current teachers trained in some other discipline, but teaching or planning to teach Computer Studies. Even teachers specifically trained as computer studies teachers experience problems when first entering their profession. Thus before embarking on the development of a new program, the deficiencies in these teachers' training need to be considered in order to better equip new teachers.

From a preliminary study into the problems experienced by current teachers, the following aspects, were mentioned.

- Their knowledge pertaining to the installing and administrating of a networked computer centre for the school, is not sufficient.
- Some teachers (especially females?) feel that they possess insufficient knowledge on computer architecture and the newest hardware developments.
- They experience some problems related to the assessment of practical work (programming) done by their learners (mark allocation in particular seems to be a problem).

Currently Unisa does not offer any courses specifically geared towards the training of Computer Studies teachers. Teachers have to do either a BSc-degree in Computer Science or a B.Comm degree in Information Systems and follow this up with a post graduate teaching diploma, where only one module (Computer Studies subject didactics) is related to Computer Studies teaching.
This prepares students well for computer related careers (programmers, database administrators, etc.) but not well enough to be good Computer Studies teachers.

Teachers who have some post-school (tertiary) training in education (trained to teach other disciplines) may be aware of a variety of teaching methods. However, because of the fundamental deficiencies in subject knowledge, they are unable to teach innovatively since they lack the confidence acquired by a solid grounding in computer science. In addition, much of the teaching theory was acquired in a context substantially different from the environment in which they work, and they have insufficient knowledge or opportunity to develop meaningful practices appropriate to their situations.

In view of this, great care need to be taken with the development of a learning program for preservice and in service teachers who may or may not already possess a secondary teaching diploma.

New Program

The current higher education system in South Africa has to be remodelled by creating a single co-ordinated higher education system (National Commission on Higher Education: 1996). This has led all Universities to design new and redesign old curricula. The new program in Science Education (Stream: Computer Studies) is one of the new programs being developed.

A *program* is a purposeful and structured learning experience designed to enable learners to achieve pre-specified exit level outcomes (Jordaan&Kilfoil:1999). It can therefore be defined as a coherent combination of units of learning (modules) expressed in an outcomes-based format which leads to one or more qualifications, serving an academic and/or vocational purpose (Reynhardt:1999). A program should have recognised entry and exit points (qualifications) and usually comprises core modules (compulsory for all students on a particular program) (SAQA:1998), elective modules (a group of modules from which a choice must be made in order to achieve the purpose of the qualification and to attain the required number of credits at a specific level) (SAQA:1998), and fundamental modules (modules which form the basis needed to undertake the education, training or further learning required in the obtaining of a qualification) (SAQA:1998).

A *module* is a coherent, self-contained unit of learning, designed to achieve a set of specific learning outcomes which are assessed within that unit of learning (Reynhardt:1999). A program is composed of a number of modules. A module has a standardised size and a designated credit-weighting in the overall program (Reynhardt:1999). One module should require 120 notional study hours (Jordaan&Kilfoil:1999). *Notional study hours* are informed estimates of the average time (spent in any variety of ways e.g. attending lectures, tutorials, practicals, independent reading and writing) that an average learner, entering with the correct level of assumed knowledge, would need to master the specific outcomes of a unit of learning (Reynhardt:1999).

The *qualifications* that can be obtained in the program are:

- a national higher certificate after completion of 12 modules;
- a national diploma after completion of another 10 modules;
- a B.Sc. degree (Science Education) after completion of another 8 modules (thus 30 modules in total).

The program will offer students recognition of prior learning in order for students who already possess a teaching diploma to be exempted from doing the education related modules. The proposed program was designed to meet both the SAQA (South African Qualifications Framework) requirements mentioned above, and the specific needs of teachers, as well as to eliminate the problems with the current training programs.

The Specific Outcomes of the Program

Students who have completed the program, will:

- Have acquired the knowledge necessary to teach secondary school Computer Studies. This knowledge includes:
- Basic computer concepts, terminology and definitions
- Computer architecture and networks
- Some basic mathematics and statistics
- Be able to assist learners in acquiring this knowledge
- Be able to use an integrated computer package and assist learners in acquiring the necessary knowledge and skills to use such a package
- Be able to analyse a problem and develop an algorithm to solve the problem
- Be able to translate this algorithm into an executable computer program by means of critical and effective use of a programming language
- Be able to assist learners in acquiring these programming skills
- Be able to provide help concerning the use of computers to other members of staff in an educational institution.
- Be a responsible computer user
- Convey an attitude of responsible computer use, taking ethical aspects into consideration, to learners
- Effectively manage a computer centre at an educational institution

Target Market of the Program

- Current teachers from all disciplines who are interested in teaching computer studies.
- Current Computer Studies teachers that don't have the necessary qualifications.
- Adults (not currently teaching) wanting to become Computer Studies teachers.

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- Lecturers at teachers training colleges and technical colleges wanting to lecture Computer Studies/Science (Degree).

Modules for the Certificate

Fundamental modules:
- *Basic Computer Literacy:* This involves the use of an integrated computer package.
- *Elementary Statistics:* Specifically related to education eg. calculation of means, modes and variances of learners' marks.
- *Elementary Mathematics:* The elementary arithmetic and algebra needed for Computer Studies.
- *English Comprehension Skills:* A module specifically developed to teach English second language students (the majority of the South African population) scientific reading and writing skills.
- *Educational Themes I:* Learning and teaching strategies in the adolescent years.

Core modules:
- *Introduction to programming I and II (2 modules):* Basic programming skills using Pascal.
- *Computer Concepts:* Basic hardware and software concepts.
- *Social Impact of Computers:* Issues such as computers and the law, computers in education, computers and medicine, ethics, privacy etc.
- *Computer Studies Classroom Practice I:* Didactical issues specifically related to Computer Studies.

Elective modules:
Any 2 modules from:
- *Theoretical Computer Science I*
- *Introduction to Business Information Systems*
- *Linear Algebra*
- *Applied Linear Algebra*
- *Precalculus Mathematics*
- *Applied Statistics*
- *Gifted child education*

Additional Modules for the Diploma

Fundamental modules:
- *Educational Themes IIA:* General teaching methods and classroom management.
- *Educational Themes IIB:* Media science, critical assessment and classroom research.

Core modules:
- *Computer Studies Classroom Practice II:* Didactical issues specifically related to Computer Studies, with special reference to assessment.
- *Computers in Education:* Issues related to the use of computers in education e.g. CAL, CAI, multimedia.
- *Introduction to programming III:* Programming in C++, including an introduction to recursion and elementary data structures such as arrays and files.
- *Data structures I:* Pointers, linked lists, trees, graphs, stacks and queues using C++
- *Data structures II:* Recursive and iterative searching and sorting methods on data structures discussed in *Data structures I.*
- *Computer organisation:* The digital logic level, microprogramming level and machine level of the computer; assembly language programming.

Elective modules:
Any 2 modules from:
- *Any of the elective modules not done for the certificate.*
- *Theoretical Computer Science*
- *System Analysis*
- *System Design*

Additional Modules for the Degree

Core modules:

- *Operating Systems and architecture*
- *Computer Networks*
- *Principles of databases*
- *Database design and implementation*
- *Computer Science Education and Logical Thinking Skills*

Elective modules:

Any 2 modules from:

- *Theoretical frameworks in education*
- *The education system and school management*
- *Multicultural education*
- *Education law and professional ethics*

AND any 1 module from:

- *Advanced programming*
- *Theory of computer science*
- *Advanced software development*
- *Software project management*

Vocational Opportunities

- Certificate: Teacher at secondary school (up to grade 10)
- Diploma: Teacher at secondary school (up to grade 12)
  Lecturer at a vast number of private institutions offering computer courses.
  Programmer
- Degree: Same as for the diploma
  Lecturer at technical college/teachers training college
  Computer Specialist/Professional
  Data base administrator
  Depending on choice of elective modules:
  Systems analyst/designer/developer
  Project manager

Conclusion

A familiar cycle of mediocrity, whereby inadequately qualified teachers are turning out students who are themselves poorly prepared for either the job market or tertiary education, has become prevalent in South Africa. The need for teacher upgrading and the delivery of new, well qualified teachers, is thus undisputed. It is believed that there is scope for a diploma and degree course specifically geared towards the training of Computer Studies teachers. Due to the fact that the majority of students that would benefit from such a course, are in service teachers, the distance education offered by Unisa would go a long way in alleviating the crisis in science education in South Africa.

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